FORCING TOMATOES.

GROWING TOMATOES UNDER GLASS FOR SPRING AND EARLY SUMMER MARKET.

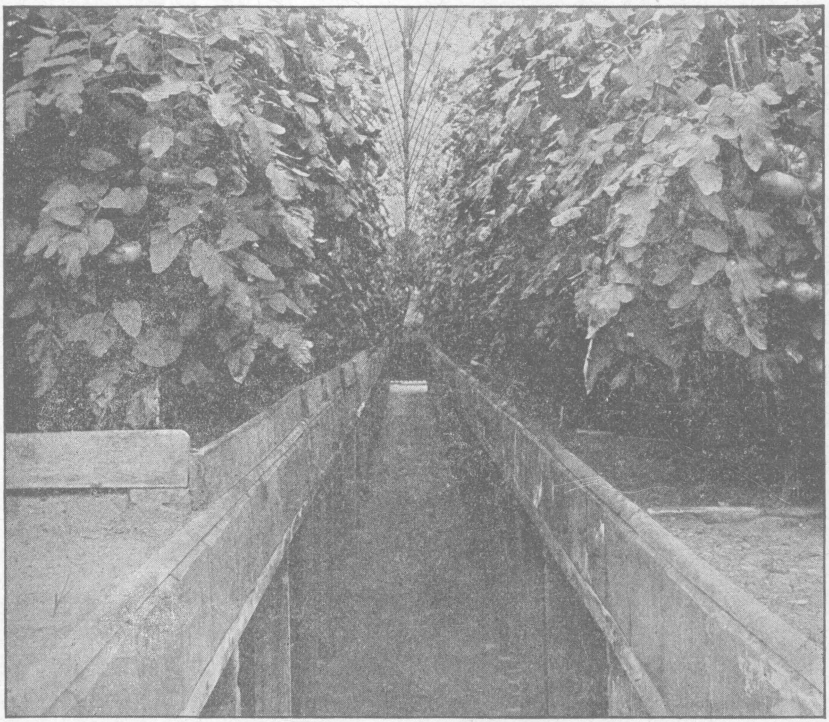
METHODS OF IRRIGATION. INSECTS AND DISEASES.

CRATING. VARIETIES.

OHIO
Agricultural Experiment Station.

WOOSTER, OHIO, U. S. A., AUGUST, 1904.

BULLETIN 153.



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[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
[2]In cooperation with the U. S. Department of Agriculture.

BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 153 AUGUST, 1904.

FORCING TOMATOES.

W. J. GREEN AND C. W. WAID.

Tomatoes have been grown under glass in mid-winter near large cities in the east for many years but the industry has gained but little foothold in Ohio. This is mainly for the reason that the prices which can be realized here at that season are not sufficient to pay thecost of production.

In Bulletin 43, published at this Station in September, 1902, the following statement was made:

"Tomatoes, cucumbers and cauliflower are forced in mid-winter near the large cities of the east, but the prices that can be obtained and the quantity that can be disposed of in Ohio, at this season of the year, do not warrant the same practice here. We have given the matter considerable attention, and have found it necessary to adopt a course quite unlike that followed in the east.

We have found that the houses can be used to good advantage in growing a tomato crop after the season for lettuce and other winter crops is over."

Conditions have not materially changed since the above was written. We have made repeated efforts to force tomatoes in mid-winter, but in no case has the price received warranted the practice. Tomatoes have been grown in considerable quantities in the greenhouse at the Station for twelve years and they have uniformly proved profitable as a spring and early summer crop. The methods herein described have either been worked out during that time or adapted from other sources and modified to suit the circumstances and conditions.

That these methods are thoroughly practicable has been fully demonstrated. A large percent of the product has been marketed in small cities near by, also in Cleveland.

The most noteworthy fact in this connection is that while these markets have been well supplied with southern tomatoes, the prices received for greenhouse tomatoes have been considerably above and often double those quoted for the southern product. This is because of the superiority of well ripened greenhouse tomatoes over those shipped in a green state from the south. There is a steady demand, even in small cities, for the home product, at prices which are remunerative.

At the season when tomatoes can be grown in the greenhouse to best advantage they are more profitable than either lettuce or cucumbers during the same period. The crop is one well deserving the attention of those engaged in vegetable forcing.

All of our tomatoes have been grown on raised benches with about six inches of soil. For this crop, benches have the advantage over ground beds in earlier maturity of fruit.

Up to and including the year 1903, the average yield secured in the Station greenhouses has been 2 lbs. and 4 ozs. per square foot, or 9 lbs. per plant, the plants having been grown two feet apart each way. Thus the yield of one house with 960 square feet of bench space, available for tomatoes, was 2160 pounds. The price during this period ranged from 20 to 5 cents per pound, going as low as the latter figure for the last of the crop in a few cases, but averaging 12 cents. Figuring on a basis of 12 cents per pound, one house gave a return of $259.20 for one crop of tomatoes.

The present season (1904) one house and parts of two others were devoted to tomatoes. In one of the houses we had a variety test and some of the varieties gave very poor yields. The actual area in tomatoes including all tests was 2400 square feet.

We began picking tomatoes June 10th, a little later than usual From June 10th to July 8th we picked 2,000 pounds of No. 1 fruit. The price during that time was 15 cents per pound. From July 8th to July 22nd, 1000 pounds were gathered and sold at 12 cents per pound. From July 22nd to August 1st the product was 600 pounds and sold at 10 cents per pound.

Thus up to August 1st, the 2400 feet had given an actual yield of 3600 pounds, which sold for $480, bringing an income of 20 cents per square foot.

There are still many green tomatoes on the vines to ripen, which if included would raise the yield somewhat, but owing to the desire to get this bulletin published as soon as possible, we thought best to include the yield for this year, up to August 1st only.

SUB-IRRIGATION VS. SURFACE WATERING.

The tomato requires an abundance of water in the soil for its best development, especially in greenhouse culture, when grown as a spring and summer crop. In our experiments we have found that by repeated watering on the surface, the soil, unless more porous than the average greenhouse compost, becomes packed and as a result, unless considerable care is exercised in watering, the lower portion of the bed will often become quite dry even though the upper surface be thoroughly soaked. This not only results in a check to the growth of the plants, but if it occurs after the fruit has become well developed it will often cause a considerable loss from dry rot.

On the other hand, when the water is allowed to rise by capillary attraction, as is the case when sub-irrigation is practiced, the soil is kept open and porous and in good condition for the free access of air and acts as a sponge in taking up and holding a large amount of water. Sub-irrigation not only gives the best growth of plants and highest yield, but it also serves as a check to the disease known as dry or tip rot.*

Table showing the advantage of sub-irrigation over surface watering of tomatoes under glass.

Method of watering.	Yield per square foot.		Average size of fruit.	Amount of rot per square foot.
	lbs.	ozs.	ounces.	ounces.
Sub-irrigated	2	4.5	5.9	1 9
Surface Watered	1	15.0	5.0	4.7

The above table gives the result of the last two years' work in making a comparison of the two methods of watering tomatoes. No mulch was used in either case. In both cases, however, particular attention was given to supplying, as far as possible, the amount of water needed for the best development of the plants. It was found more difficult to supply a sufficient amount of water to the surface watered area and it required much more time and attention than the sub-irrigated section.

*See Insects and Diseases.

With two houses, each having 960 square feet of bench space planted to tomates and both treated alike except in the manner of watering, the sub-irrigated house would yield, calculating the yield according to the above table, 330 pounds more tomatoes than the surface watered house. The surface watered house would give, on the other hand, 168 more pounds of fruit affected by rot. Not taking into consideration the extra labor required to water and to pick the rotten fruit the sub-irrigated house would bring a return (figuring the price of tomatoes at 12 cents per pound) of $39.60 above that of the surface watered house.

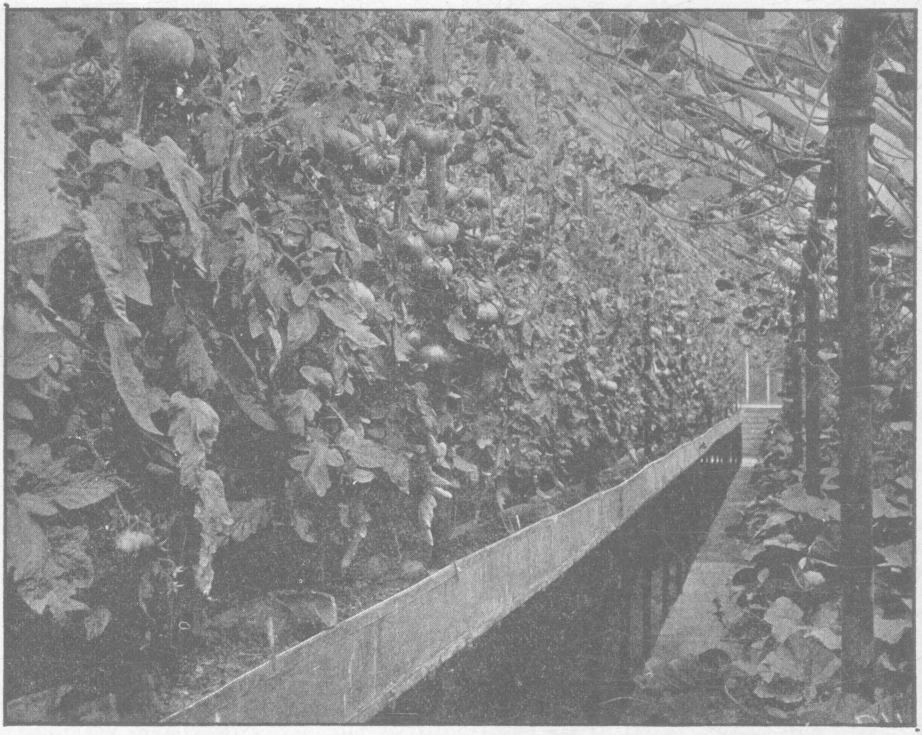

FIG. I—A good setting of fruit.

MULCHING.

Mulching with strawy manure accomplishes the same results as sub-irrigation. It is more beneficial, however, with surface than with sub-watering.

B. H. Thorne has quite extensive greenhouses located near Wooster. His houses are constructed with solid ground beds throughout, and arranged for sub-irrigation. Mr. Thorne has been growing tomatoes as a spring and early summer crop for several years with very good success.

He waters by sub-irrigation and uses a mulch. He has secured the best results by mulching as soon as the tomatoes are planted in the bed, and allowing the surface of the mulch to become dry and remain in that condition for some time. If the mulch is kept wet on the surface from the start the presence of the moisture seems to bring about conditions which promote disease. Toward the close of the season he surface waters the mulch and thus washes some of the fertility out of the manure into the soil where it is available for the crop when it is most needed. Where the water supply is scanty mulch should be used, whatever method of watering is employed, and it will be found beneficial in all cases.

DISTANCE OF PLANTING AND METHOD OF TRAINING.

Our usual custom has been to set tomato plants two feet apart each way. In 1902 and 1903 we set the plants one foot, one and one-half, and two feet apart each way. All of those planted one foot apart each way were trained to one stem. Some of those planted one and one-half foot each way were trained to one and some to two stems. Some of those planted two feet apart were trained to one stem and the remainder to two stems.

Table giving the results of the tests of different distances of planting, and different ways of training tomatoes.—Seasons 1902 and 1903.

Distance apart planted.	Method of Training.	Yield per square foot	Average size	Rot per square foot
		lbs ozs	ounces	ounces
1 x 1 foot	One stem	3 1.8	4.8	1.10
1½ x 1½ foot	One stem	1 15	5.1	1.31
1½ x 1½ foot	Two stems	2 12	5.6	.64
2 x 2 feet	One stem	1 13	5.7	1.26
2 x 2 feet	Two stems	2 1.8	5.5	3.31

Referring to the table it will be seen that the plants set one foot apart each way gave the highest yield per square foot with a loss of nearly one ounce in average size of fruit, while the amount of rot was next to the smallest of any of the different distances planted apart.

The plants set one and one-half foot apart and trained to two stems were second in yield and the average size was not affected. Those planted two feet apart and trained to two stems were third in yield and highest in amount of rot.

These facts indicate that in planting two feet apart each way, as has been our custom, we have not crowded the plants as closely as we might to secure the highest yield per square foot.

After securing the above results we thought best to make a similar test on a larger scale, therefore we planted 240 square feet to the Stone variety set 2 feet apart each way and trained to two stems, and 240 square feet to the same variety set one foot apart each way and trained to one stem. The test was repeated with 336 square feet planted to Beauty divided in the same manner as with the Stone.

Table giving results of thick and thin planting of Tomatoes—1904.

VARIETY	Distance apart planted	Yield to July 8	Yield to Aug. 1	Average size to July 8	Average size to Aug. 1	Yield per square foot to July 8	Yield per square foot to Aug 1
	feet	lbs ozs	lbs ozs	ozs	ozs	lbs.	lbs.
Stone.....	2 x 2	278 14	406 10	6 7	6 3	1 16	1.69
Stone.....	1 x 1	372 1	472	5 6	5 4	1 54	1.97
Beauty.....	2 x 2	107 11	260	4 7	4.9	64	1.55
Beauty.....	1 x 1	171 12	250 11	4 1	3 9	1.02	1.49

By referring to the above table we see that the varieties did not behave quite alike. The thick planting gave the best yield with the Stone but the result was less marked with the Beauty. Each variety, however, showed a marked advantage for the thick planting over the thin, so far as early maturing is concerned.

As the price of tomatoes is always much higher during the first of the season early maturing is a great advantage. Figure IX shows one picking of Beauty made July 4th, the larger number of tomatoes being from the thick planted area. Up to this time the thick planting had given much the larger yield, as shown in the table, and this picking showed the greatest contrast of any, there being 51 pounds and 202 tomatoes on the thick planted area, and 20 pounds and 67 tomatoes on the thin planted area. Up to July 8th we received 15 cents per pound for the tomatoes; after that the price rapidly fell. Thus, even though the total yield of Beauty was slightly in favor of thin planting, the early ripening of the fruits on the thick planted area throws the balance strongly on the other side. With the Stone variety the early ripening was not only very marked but the total yield was much in favor of thick planting. While these results are not conclusive, they warrant continuing the experiment along the same lines.

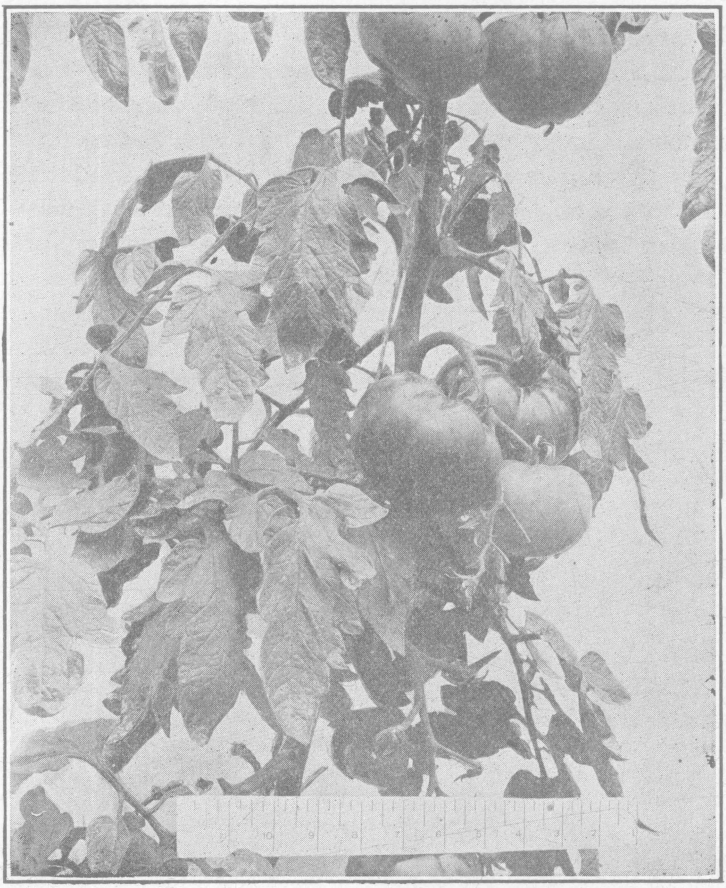

FIG. II—A tomato vine trained to one stem.

CARE OF TOMATOES.

For the spring crop of tomatoes we usually sow the seed in flats about the first of December. When the plants are of sufficient size for handling they are transplanted, or "pricked off" into flats, setting them about three inches apart each way. As soon as there are any signs of crowding they are again transplanted, but this time into pots. If the grower has the time, it is best to start with small pots, say two-inch, and make two or three shifts, but where time is limited, as is usually the case with greenhouse work, the plants can be transplanted from the flats into 2½-inch pots and later into four-inch, where they can remain until ready to be planted in the beds.

The time required to grow plants ready for setting in the beds depends on the temperature of the house in which they are grown and on their care; this will vary from three to four months in winter under ordinary conditions. They should not, however, be kept in too high a temperature or given too much water during this stage of growth, as such treatment will induce slender, weak plants. Crowding in flats or pots will cause the plants to grow spindling, thus they should be given plenty of room. The aim should be to secure a good, strong, stalky plant, ten to fifteen inches in height.

Plants from seed sown December 1st, with good heat and proper care, will be ready for the bed by the middle of March.

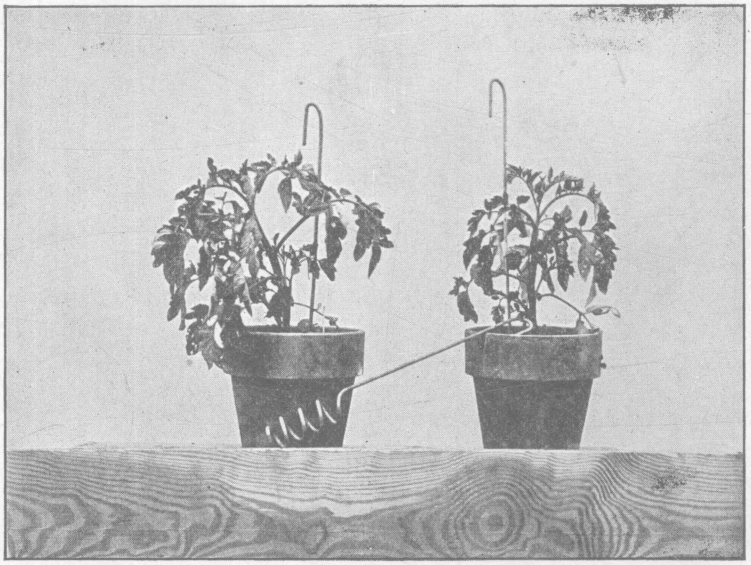

FIG. III—Tomato plants ready to place in permanent beds. Showing kind of wire used to attach twine to and wire in place.

Before setting the plants in the permanent beds, wire supports should be provided and these can be placed in the pots. (Fig. III) These wires have a hook at the upper end and are made in the form of a cork-screw at the lower end. They retain their hold upon the soil much better than stakes.

We usually plan to have a lettuce crop ready to take off at the time or a little before it is desired to set the tomato plants in the beds. At the same time tomato plants are set in the bed lettuce plants are set between the tomato rows, and as this comes at the time

of year when the days are lengthening the crop of lettuce grows quickly and is out the way before the tomato plants are of sufficient size to do any harm to the lettuce plants. When the tomato plants are set closer than two feet the lettuce will not do as well as when the distance is two feet, and when the tomato plants are as close as one foot each way it will not pay to grow a crop of lettuce with the tomatoes.

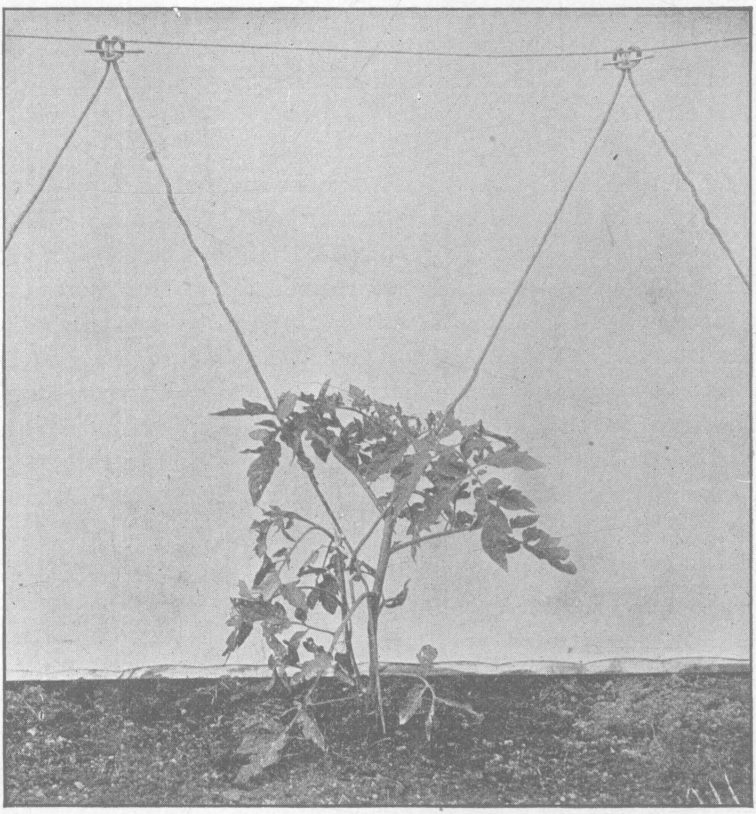

FIG. IV—Wire and twine in place showing method of training to two stems.

With our raised benches we have found it convenient and very satisfactory to train the tomato plants to a wire run along the rafters, fastened to them by screw-eyes and extending directly over the rows, the length of the house. With the cork-screw wires in place near the plants and the one stretched overhead the matter of training is very simple.

We have found strong, coarse wool twine the most satisfactory support. Two things are essential for this support, first, that it

be strong, and second, that it be rough, so that raffia when tied around it will not slip easily. When the plants are to be trained to one stem, (Fig. II) the twine can be cut in equal lengths and one strand tied in the loop in the wire below and to the wire above. When the plants are trained to two stems there is no need of cutting the twine except at the end of each row. Short pieces of stiff wire about one inch in length should be provided, and the twine can be tied to the upper wire at one end, then hooked into the loop of the first lower wire, then up to the upper wire again and fastened as shown in Fig. IV. This method of training is very simple and takes very little time.

We have found raffia the most satisfactory material to tie the tomato vines up with, and for convenience it is cut in short lengths. The raffia is first tied tightly around the twine, one knot is sufficient, and a little above a leaf or fruit spur, then it is tied loosely around the vine under the spur. It is a simple matter to train plants to one stem because in that case all that needs to be done is to trim or pinch off all shoots except the upper or primary. Where the plants are trained to two stems there is need of a little more care in pinching off the side or secondary shoots (suckers). As a rule the branch that starts out just below the first fruit spur is the strongest, and when possible this should be chosen for the secondary stem. In pinching off the side branches or suckers it is necessary to go over the plants every few days, as these lateral shoots grow very rapidly and unless taken off when small they sap considerable strength from the plants.

Care should be taken never to remove the tip of the primary or secondary shoot; the removal of this would cause the loss of one fruit spur and thus several fruits. Owing to the severe pruning to which the plant is subjected it frequently occurs that the fruit spur sends out a sucker; this should always be removed.

The pollination of the flowers is an operation that requires time and a large amount of perseverance. To aid us in this work we have a wooden ladle, about half the size of a teaspoon with a handle about 18 inches in length. As a companion to this we have a flat wooden spatula, about the size of the spoon part of the ladle with a handle of equal length. (Fig. V) When the blossoms open and appear ready to be pollinated, place the spoon portion of the ladle underneath the flower and gently tap the same flower from above with the spatula. This causes the pollen to fall into the ladle, and after several plants have been treated there is usually a sufficient amount of pol-

len to be plainly visible. After this stage of the process is reached the blossoms are pressed down into the ladle until the pistil touches the bottom, when it is quite sure to take up some of the pollen. The blossom is jarred also so that any pollen which may be in condition to leave the flower will fall into the ladle and thus help to keep up the supply. Unless there is pollen in the ladle from the previous day's pollinating it will be necessary to go over the first blossoms treated the second time. (Pollen may be kept over from one day to another.)

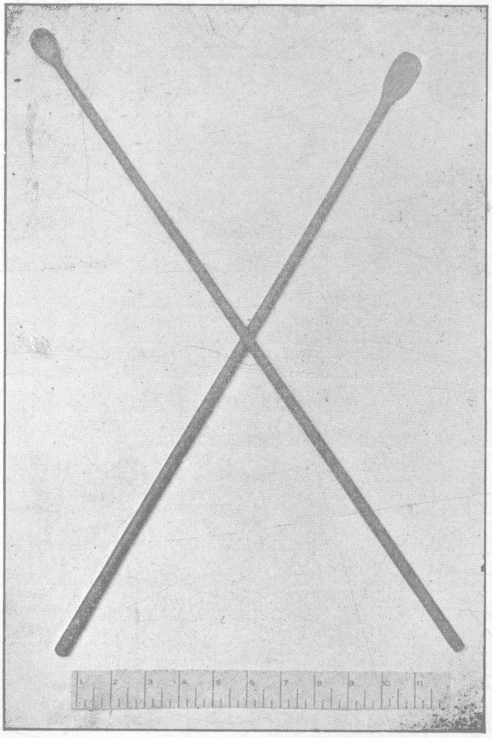

FIG. V—Home made pollinating tools.

The best results are usually obtained from daily pollination; however, if the grower is limited as to time, one half can be gone over one day and the other half the second, thus giving each plant treatment every other day. The pollen is most abundant on bright days, although on dark days following several bright days there seems to be a good supply. After days of a scanty supply particular care should be exercised to continue the work or some of the flowers may pass the period when they can be successfully pollinated without having received any pollen. Faulty pollination is shown in irregular, one-sided fruits, or in no fruit at all. Success in tomato forcing depends more on thorough and careful pollnaition than on any other one thing.

The atmosphere of the house should be kept comparatively dry, as a damp air not only hinders pollination but facilitates the growth of disease germs. The day temperature of the house should be 70° Fahr. or above, and the the night temperature should not be allowed to fall much below 60°, especially during the early growth of the plants. On damp, chilly days artificial heat should be used, even though the temperature of the house be fairly high. It is not necessary to whitewash the glass, as tomatoes can stand a very high temperature when the sun is the immediate source of heat.

INSECTS AND DISEASES.

The green fly, or aphis, is quite friendly to the tomato, but it is easily controlled by the use of some form of tobacco fumigation. We have used tobacco stems almost exclusively and find them very effective, cheap and easy to procure.

The white fly or Plant House Aleyrodes, (Fig. X) is not so common nor as easy an insect to deal with. It seems to have attracted more attention in the New England states, for the Connecticut,* New Hampshire,† and Maine‡ Stations have each published a bulletin on the subject. It has only been in the last two years that the Ohio Station has had to deal with this pest. Because of the fact that it is but little known and at the same a dangerous and difficult insect to control after it has become established, we give the method of treatment quite fully in this publication.

It was first discovered here on the pelargoniums (Lady Washington geraniums) but it soon spread to the cucumbers and tomatoes and it was on these plants that it did the most damage. The presence of the little insect can be detected by making an examination of the under side of the leaves of the plant. In the adult stage when disturbed it will fly around the plant and usually return to the same plant. In the egg and nymph stages they are attached to the under side of the leaf, and to the naked eye in both stages they appear to be eggs. With the use of a glass the difference can easily be detected and is apparent in the more life-like form of the nymphs. According to observation made at the New Hampshire Station, it takes 13 days for the eggs to hatch into nymphs; these nymphs move about over the under surface of the leaf for a few hours and then insert their tiny beaks into the tissue of the leaf, taking on the ap-

*Connecticut Station, Bulletin 140. The White Fly or Plant House Aleyrodes.
†New Hampshire Station, Bulletin 100. The White Fly of Greenhouses.
‡Maine Station, Bulletin 96. Plant House Aleyrodes.

pearance of a scale. These scales remain in position two weeks or more, until finally, in about five weeks, according to the Connecticut report, a T shaped rupture appears in the back skin of the insect and the adult white fly emerges.

This insect has sucking mouth-parts and thus cannot be controlled by the use of poisons. The milder forms of fumigation with tobacco have no appreciable effect. The Connecticut and other eastern Stations recommend fumigation with Hydrocyanic acid gas. This was used as recommended with good success. We used one ounce of potassium cyanide per 1000 cubic feet of space and according to the following formula:

One ounce, fused cyanide of potassium.
Two ounces (by measure) commercial sulphuric acid.
Four ounces (by measure) water.

In a house 100 feet long and containing 16,000 cubic feet of space four earthen jars were used. The 16 ounces of cyanide were divided into four equal parts and placed in firm paper sacks. The water was then measured and poured into the vessels, adding the acid to the water (do not pour the acid into the vessel before putting in the water.) After seeing that every door except one was closed and locked or fastened, we distributed the vessels about equal distances apart down one aisle or path. Starting at the end farthest from the door from which he wished to make exit, the operator took a full breath and hastily but carefully dropped a sack into each vessel. Then the exit door was quickly closed and a notice posted so that no one would enter the room while the fumigation was going on. To suspend the sacks by strings over the vessels and allow them all to drop at once from one end of the room would be a safer means to employ. After about thirty minutes the ventilators were raised slightly and the gas permitted to pass off No one was permitted to enter the room until the gas had had plenty of time to escape; this required one hour or more.

The fumigation was done in all cases after the sun had gone down and when it was nearly or quite dark. It is claimed by some authorities that to fumigate when the sun is shining adds to the danger of damage to the foliage. The foliage should be as dry as possible, as the presence of moisture increases the liability of injury to the foliage. If there is no way of ventilating from without, some means should be provided before the fumigating is done, as it would be very dangerous, and perhaps fatal, for any person to en-

ter the room before the gas had been allowed to escape. It is advisable for two men to be present, one not entering the house, to guard against accident. If one of the men should be overcome prompt action is necessary to restore him.

The first fumigation should be given as soon as the presence of any of the adults is discovered. They may be detected by gently jarring the plants, as the insects are easily disturbed and readily seen when on the wing. Other fumigations should be given whenever a few more of the adults have emerged.

The tomato plant is very tender and injury to the foliage is liable to occur from the use of this gas if all details are not carefully looked after. Seedlings of tomatoes as well as of other plants will not endure as heavy charges of the gas as will the older plants. Some flowering plants are very easily injured by the gas. The white fly, when present only in small numbers and on a few small plants, can easily be destroyed by pinching between the thumb and fingers.

The New Hampshire Station report speaks of the secretion made by the white fly, which not only closes the pores of the leaves but supports a dark-colored fungus, which covers the entire under surface of the leaves, making them appear as though covered with soot. (Fig. X) We have noted the same effect and the fungus often becomes so plentiful that the plant appears to be badly diseased. There has been no insect at the Station that has been more destructive to the tomato and more difficult to combat than the white fly.

The leaf-blight of the tomato, (*Cladosporium fulvum*) Cooke, described in Bulletin 105 of this Station, has been one of the most troublesome diseases with us for the past two years. The use of Bordeaux very early in the development of the trouble has given fairly good results, but when the disease gets well established the remedy has but little effect. This would seem to indicate that in this case the value of Bordeaux is more as a preventive than as a remedy. If the disease can be held in check until the crop has nearly reached maturity but little harm will result, as its presence in a mild form hastens the ripening of the fruit.

The dry or point rot of the tomato, while very destructive when allowed to have its way, has not been very troublesome with us except in cases where surface watering was done as an experiment, or where in any way the water supply was reduced below the normal. As stated in previous bulletins, published by this Station, and

written by Prof. Selby, an abundant supply of water at all times during the growth of the plant, and especially after the tomatoes have reached a considerable size, is an easy and sure preventive of the trouble. Give the plants all they can drink and there will be little or no dry rot.

MARKETING.

The tomatoes from the Station greenhouses are sold to grocerymen either in Wooster or other nearby cities. The fruit is very carefully graded, all very small or inferior tomatoes rejected. The No. 1 grade is the only one put on the market except when an order is received for the second grade, which constitutes a very small per cent of the crop. All stems are removed and when necessary all the tomatoes are wiped with a cloth.

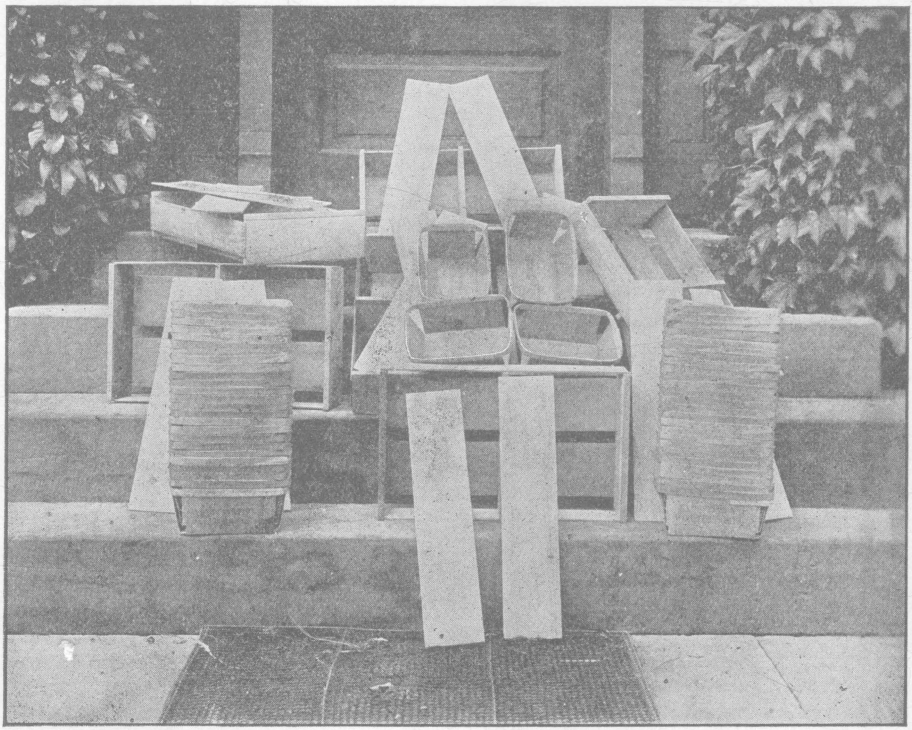

FIG. VI—Basket and crates ready for tomatoes.

The baskets shown in Fig. VI hold five pounds level full. We usually select uniform sized tomatoes for the top of the box and place them with the stem end down. This method of packing makes a very attractive display in the show window of a grocery store.

The crates shown in Fig. VII make a very convenient size to handle and the tomatoes are held firmly in place, thus preventing any considerable injury by repeated or rough handling. Tomatoes put up in this way always bring the highest market price, which ranges from 5 to 20 cents per pound with an average of about 12 cents per pound.

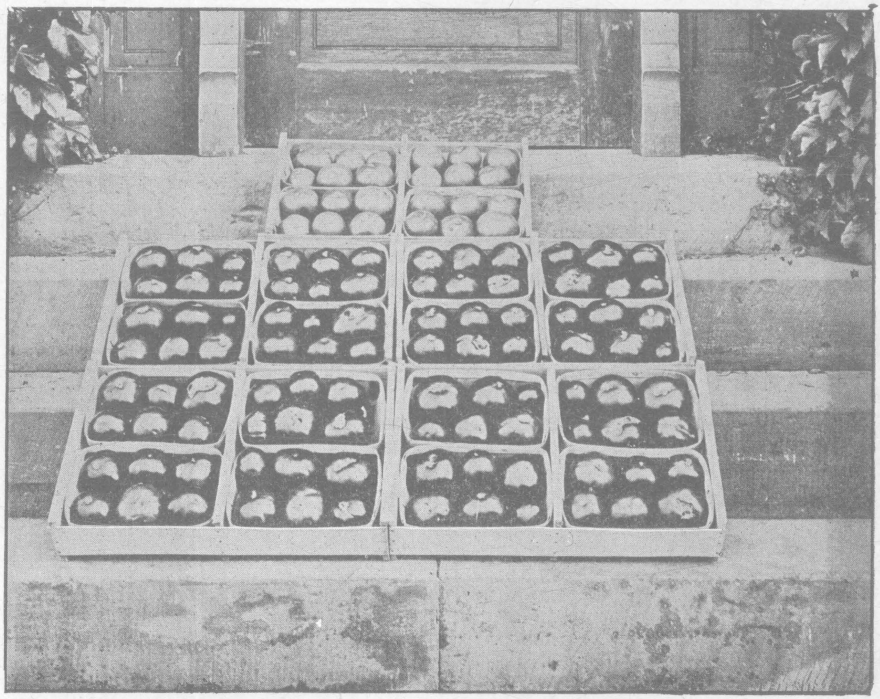

FIG. VII—Tomatoes in crates ready to cover.

VARIETIES.

The tomato when forced is much more inclined to grow irregular than when grown out of doors, hence in selecting varieties for forcing it is essential that they be those that naturally grow regular in form. Forcing also reduces the size somewhat and affects the fruit in other ways of less importance. It is evident therefore, that many varieties that do well in the field are not suitable for growing under glass.

The Stone and Beauty varieties have been the ones used for forcing at this Station. The Stone is a heavier yielder than the Beauty and on account of greater firmness a better shipper, but the Beauty is more attractive in appearance than the Stone and is there-

fore more satisfactory for the home market. The Beauty will ship short distances in good condition but is hardly firm enough for long distance shipments. These varieties are both of large size, especially the Stone. When grown on raised benches they are sometimes larger than necessary. The market desires tomatoes of uniform and medium size, as the common method of serving, especially at hotels and dinner parties, is to use one fruit to each dish, cut in halvesand covered with a dressing. The size most satisfactory for this purpose seems to be about 2½ inches in diameter and weighing 3½ to 4 ounces.

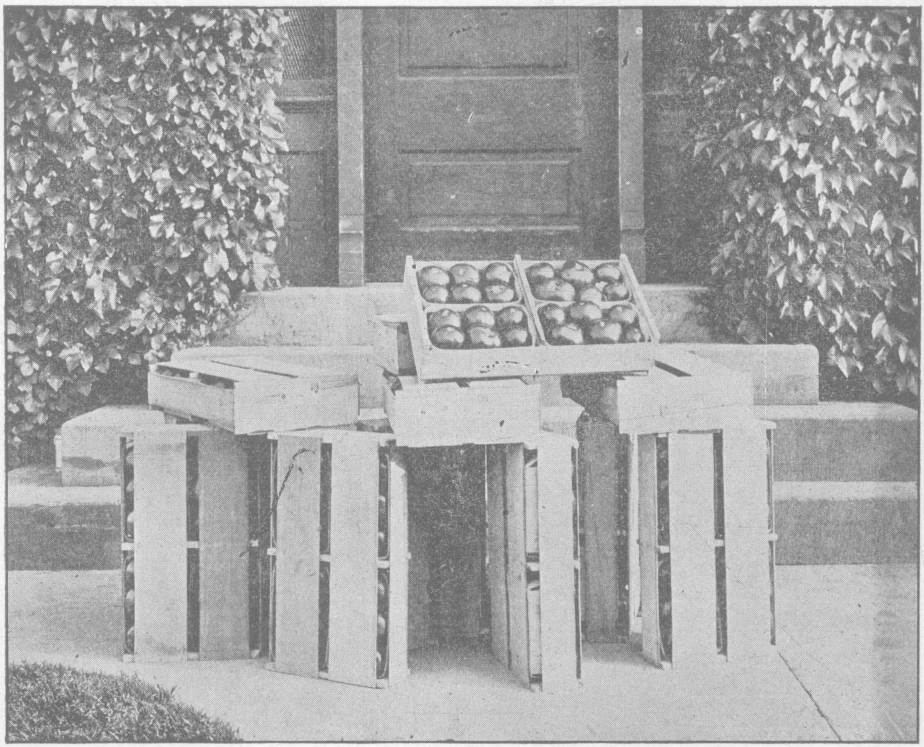

FIG. VIII—Tomatoes ready for shipment (except upper crate). One day's picking.

With the thought in mind of trying to find a variety that would give a yield equal to or better than either the Stone or Beauty, and at the same time would more nearly meet the demands of the market as to size, we have begun a variety test. As it was desired to include a number of varieties in the preliminary test made this year, (1904) we were unable to grow more than four plants of each variety.

The following table gives the yield, up to July 8th, of some of the varieties tested, to show comparative earliness of the same sorts and to August 1st to show comparative total yield. It must be borne in mind, however, that it is but one season's test on a small scale and is, therefore, by no means conclusive.

Table giving yield of some of the varieties tested, season 1904, four plants of each variety.

VARIETY	YIELD TO JULY 8th		TOTAL YIELD TO AUGUST 1st		AVERAGE SIZE	SEEDSMAN
	lbs	ozs	lbs	ozs	ozs	
Beauty	16		35	10	6 3	Livingston
Belmont	17	5	25	8	4.6	Rawson
Combination	22	13	52	5	7.3	Thorburn
Crimson Cushion	20	2	33	9	6.9	"
Crimson Whirlwind	22	14	46	3	4.2	Salzer
Dwarf Aristocrat	15	12	31	9	3.5	Livingston
Dwarf Champion Imp	15	13	29	5	4.2	"
Dwarf Champion Early	8	14	27	1	3.6	Vaughan
Dwarf Scarlet Champion	14	5	23	10	4.1	"
Dwarf Stone	12	2	22	7	5.1	Burpee
Earliest of All	24	14	47	8	4.6	Salzer
Early LaCrosse Seedling	10	12	18	13	3.6	"
Favorite	18	11	43	1	5.9	Livingston
French Marvel	20	11	35	13	4.3	Johnson & Stokes
Frogmore's Selected Forcing	27	9	49	6	4.8	Vaughan
Kansas Standard	10	1	16	13	5.0	Burpee
Lorillard	18	2	34	3	5.1	Thorburn
Magnus	17	14	32	12	5.6	Livingston
Maule's Earliest	16	5	30	10	5.4	Maule
Mayflower Early	24	12	38	8	4.8	Salzer
Noltes	21	6	41	1	5.1	Gregory
Noltes Earliest	35	6	50	13	4.9	Burpee
Perfection	12	12	29	9	5.4	Livingston
Potato Leaf	13	13	25	4	4.3	"
Potomac	17	4	38	10	5.0	Harris
Puritan, Rawson's	18	5	37	10	5.8	Rawson
Quarter Century	8	7	24	15	4.6	Burpee
Quicksure	22	2	37	8	5.1	"
Royal Red	13	13	37		5.8	Livingston
Spark's Earliana	14	5	26	2	5.0	Burpee
Stirling Castle	12	8	34	11	2.2	Thorburn
Stone	12	13	30	10	7.0	Harris

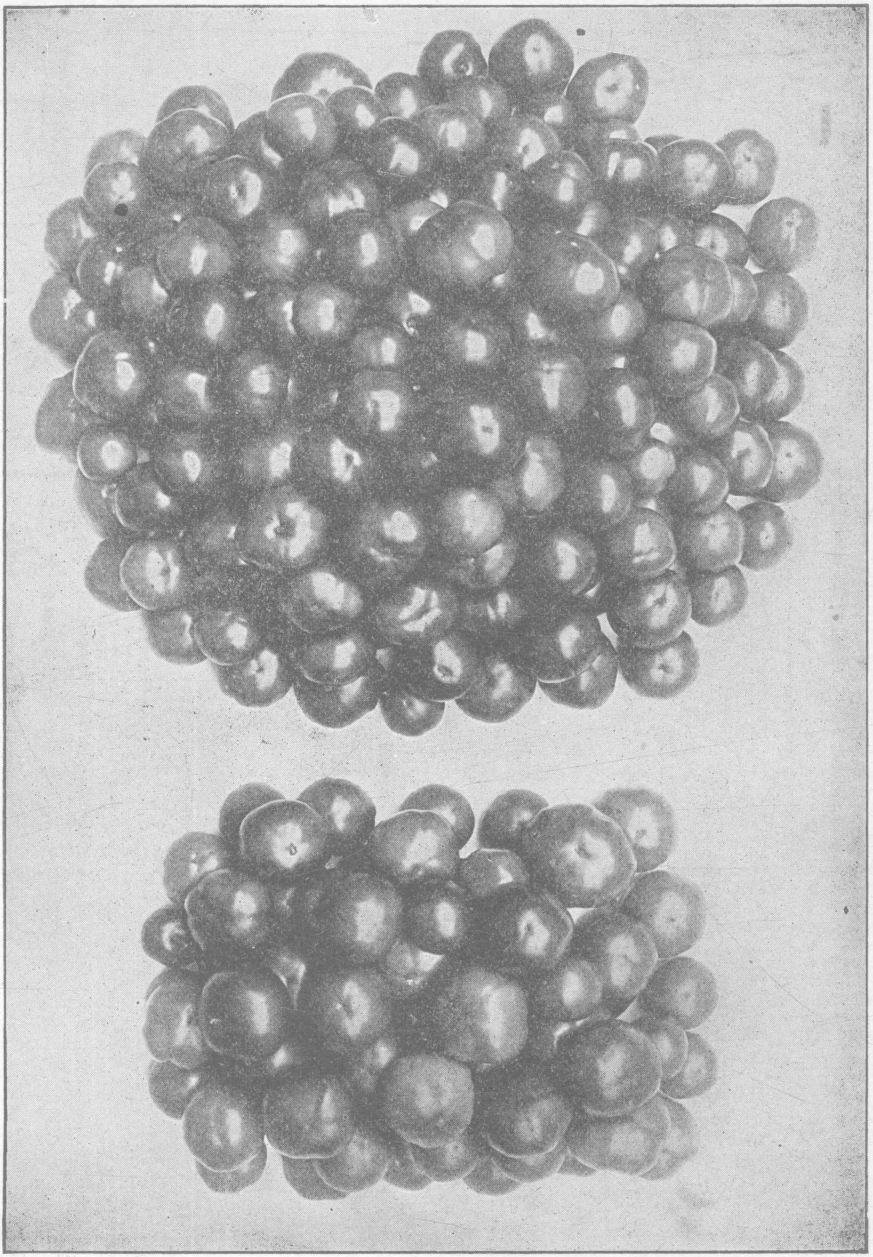

FIG. IX—One day's picking from thick and thin planting, same area; the larger quantity from the thick planted plot. Variety, Beauty,

FIG. X—A cucumber leaf infested with White Fly (*Aleyrodes*) A few adults and many nymphs and eggs are visible. The brown spots are the fungus that lives on the secretion of the White Fly.

BRIEF NOTES ON SOME OF THE VARIETIES TESTED.

Beauty—A standard purple variety for outside or inside growing. Not as heavy a yielder as Stone, but more regular in form and more beautiful, as the name implies. Excellent for home market and short distance shipments. Will not stand long distance shipment as well as Stone.

Bond's Early Minnesota—Fruit too small to be of value for forcing.

Combination—A strong growing variety. Leaves resemble those of the Magnus but are more abundant. Fruit red, large, firm, slightly irregular, very prolific, apparently a good shipper. Promising.

Crimson Cushion—Foliage thrifty, not as rank as some but sufficiently dense for good results. Fruit red; mostly quite regular; fairly prolific.

Crimson Whirlwind—Foliage rank; fruit slightly irregular; good color; very prolific; promisins.

Dwarf Aristocrat—Vines very much like Dwarf Champion. Fruit red, resembling Stone; firm, fairly prolific.

Dwarf Champion—Foliage thrifty. Vines did not grow to full height of house, when trained to two stems. Fruit resembles Beauty in color but is not quite as regular in form, nor as prolific. Worthy of trial planted one foot each way.

Dwarf Scarlet Champion—Vines not as strong in growth as Dwarf Champion and slightly more susceptible to disease. Fruit resembles Stone in color; not very smooth. Not as prolific as Dwarf Champion.

Dwarf Stone—Vines about the same in growth as Dwarf Champion. Has very large, coarse leaves. Fruit resembles Stone in color, slightly darker; larger than Dwarf Champion; in fact the largest of any of the dwarfs. Worthy of trial for close planting.

Early LaCrosse Seedling—A somewhat dwarfish, purple variety. Did not yield as well as test outside would indicate.

Earliest of All—Foliage thrifty, stalks strong, fairly resistant to disease. Fruit red, slightly darker than Stone; good form, slightly inclined to crack; fairly firm. Not only yields well early in season but holds up in yield late in season. A very promising variety.

French Marvel—Vines strong in growth. Fruit red, smooth, firm, of fair size and fairly prolific.

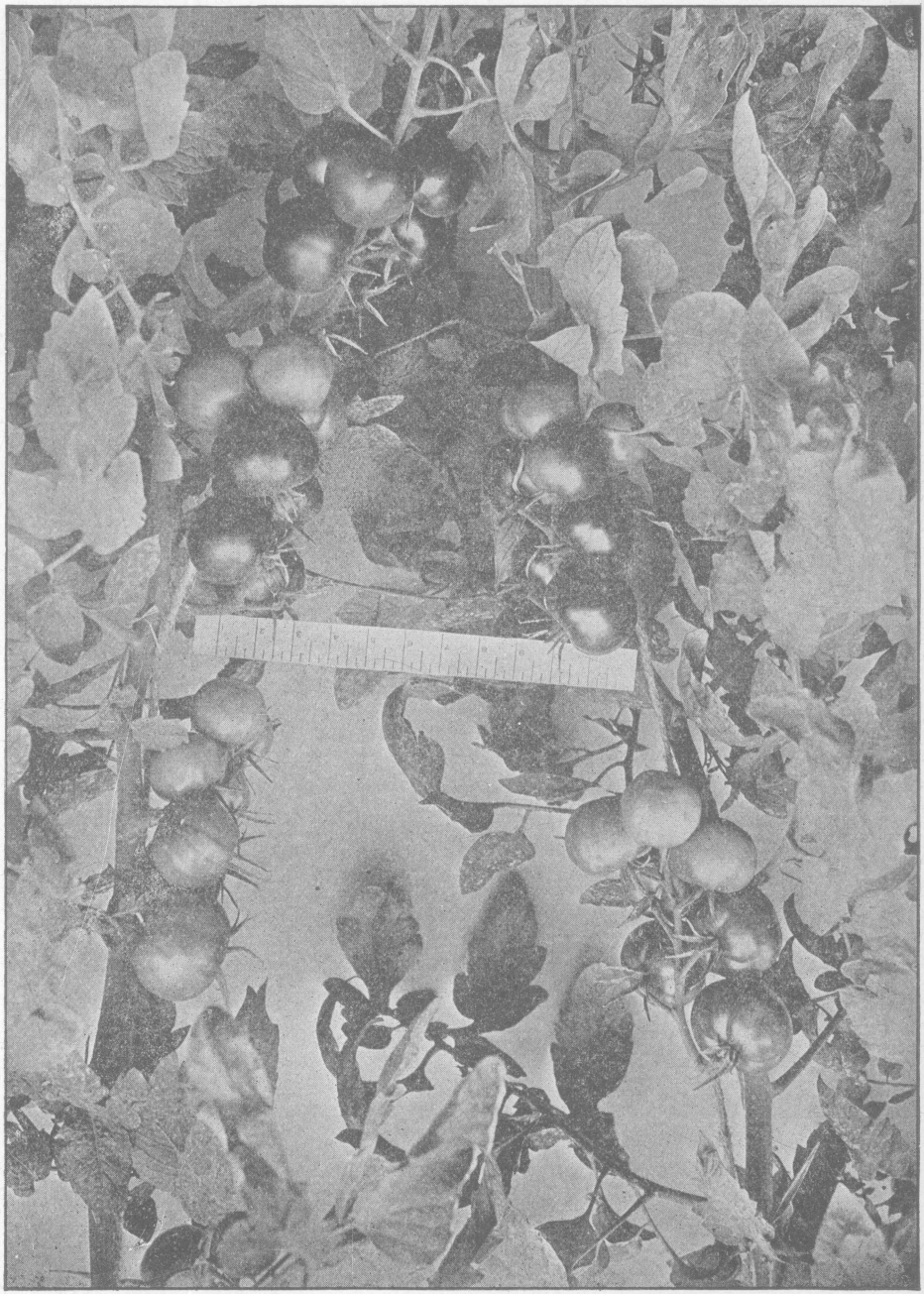

FIG. XI—A finesetting of fruit. Variety, Frogmore's Selected Forcing. This plant set and developed 75 fruits. One of the most promising varieties tested.

Frogmore's Selected Forcing—Plants vigorous and very prolific; stalks very long and set with fruit to tips. Fruit red, smooth, fairly firm. (Fig. XI) The only apparent defect is that the fruit may not prove large enough. It is, however, the most promising variety tested this year.

Lorillard—A variety that has been used for forcing for some time, especially in the east. Foliage quite open; vines long, quite prolific. Fruit red, of a desirable size, firm.

Magnus—Foliage very open, although the leaves are very large. Fruit purple, not quite as smooth as Beauty nor as uniform in size. A good variety for forcing in ground beds on account of open foliage. Not very resistant to disease.

Maule's Earliest—Fruit too rough to be of value for forcing.

Mayflower—An open foliage variety. Fruit somewhat irregular, prolific. Vines susceptible to disease.

Nolte's Earliest—Very prolific but too irregular to be of value for forcing.

Potomac—Plants vigorous. Fruit purple, of good size and form, prolific; promising.

Puritan, Rawson's—Plants vigorous; somewhat susceptible to blight. Fruit red, fairly smooth, prolific.

Purple Dwarf—Not prolific enough to be of value.

Quarter Century—Plants dwarfish in growth, vigorous. Fruit red, smooth; not very prolific.

Quicksure—Foliage not as rank as most varieties. Fruit fairly smooth; prolific.

Royal Red—Very rank foliage, with dark, heavy leaves, so dense as to invite disease. Fruit red, darker than Stone, fairly smooth, not uniform in size; prolific.

Spark's Earliana—Fruit too rough to be of value for forcing.

Stirling Castle—Fruit too small to be of value.

Stone—A standard variety both for out doors and for forcing. Foliage more dense than Beauty. Fruit red, very firm; prolific. A heavier yielder than Beauty and better for long distance shipments.

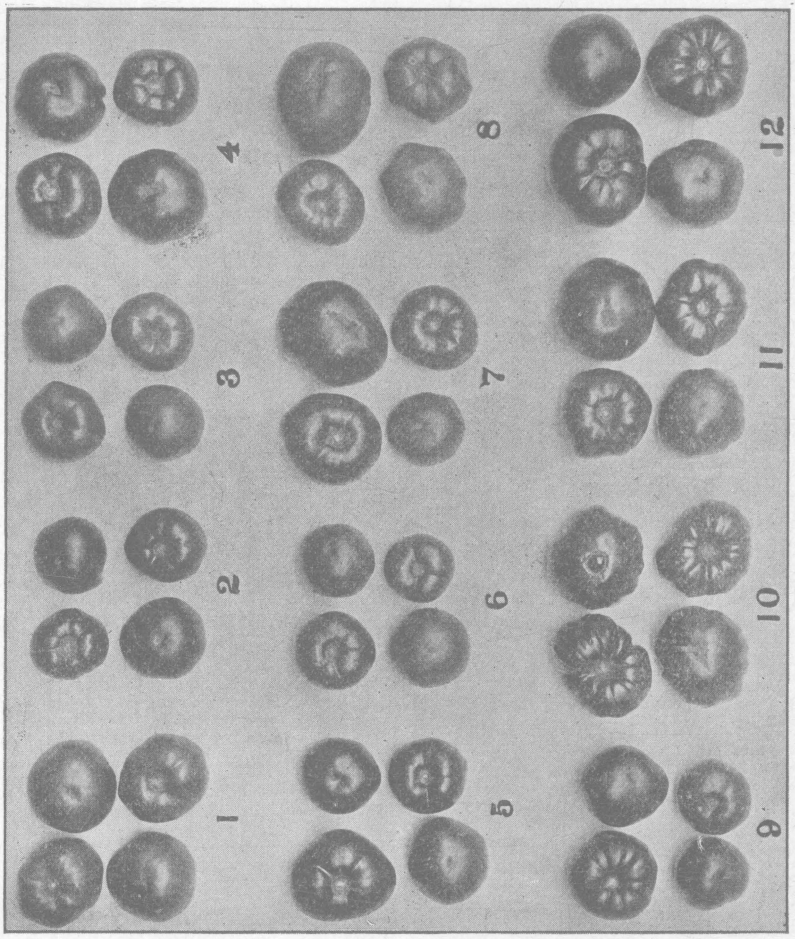

FIG XII—Specimen fruits of some of the varieties tested this year. 1904

1 Beauty.
2 Dwarf Aristocrat.
3 Champion.
4 Dwarf Stone.
5 Earliest of All.
6 Frogmore's Selected Forcing.
7 Livingston's Favorite.
8 Magnus.
9 Mayflower.
10 Nolte's Earliest.
11 Rawson's Puritan.
12 Stone.

SUMMARY.

1 Tomatoes have been forced as an early summer crop at the Ohio Experiment Station for about twelve years with uniformly good results and the product has been sold at remunerative prices.

2 While the prices in the eastern markets are sufficiently high to warrant the mid-winter forcing of tomatoes in that section, the prices received here at that season of the year are not sufficient to cover the cost of production.

3 At the Station tomatoes forced in spring and early summer have not only sold readily but the cost of production is so much less at that season than in mid-winter that they have proven a very profitable vegetable for forcing.

4 Greenhouse tomatoes, because of superior quality, sell more readily and at much higher prices than the southern grown product on the same market.

5 At the Station, tomatoes grown in the spring have been much more profitable than either lettuce or cucumbers grown at the same season.

6 The average yield has been over two pounds per square foot and the average price 12 cents per pound. Thus the returns have been more than 20 cents per square foot of bench space.

7 Raised benches have the advantage over ground beds in earlier ripening of fruit.

8 Sub-irrigation or mulching is essential to success in tomato forcing and it is advantageous to combine both methods.

9 Ordinarily the tomato plants were set two feet apart each way and trained to two stems, but recent tests seem to indicate that plants set one foot apart each way and trained to one stem will give a higher yield and ripen earlier.

10 For a spring and early summer crop the seed should be sown in flats about the first of December. The plants may be pricked off into pots or flats, flats being more economical. The second and third shifts should be made into pots.

11 Under ordinary care plants from seed sown December 1st will be ready to set in the permanent beds about the middle of March, and the fruit will begin to ripen from the first to the middle of June.

12 Stiff wire, with a hook at the upper end and made into the form of a cork-screw at the lower end, screwed into the soil near the plant, is a very satisfactory device to which to attach the lower end of the twine that serves as a support to the vines.

13 Strong twine running from the hook in the cork-screw wire to a wire stretched directly over the row of plants and fastened to the rafters, is a more satisfactory support than stakes.

14 In training plants to one stem all side branches should be kept pinched off. When training to two stems the lowest strong branch, which is usually the one just below the first fruit cluster, should be left for the secondary stem. All other branches or suckers should be kept pinched off.

15 Hand pollination is a necessary operation in the successful forcing of tomatoes. A wooden ladle and a spatula, with handles about 18 inches in length are very convenient and helpful in doing this work. A dry atmosphere facilitates pollination.

16 The temperature of the house should be about 60° Fahr. at night and the day temperature can be allowed to run up to 80° with artificial heat and to 100° or more with sun heat. No whitewash is needed on the glass.

17 The white fly or Plant House Aleyrodes is a troublesome insect to combat in tomato forcing. It can be controlled by fumigation with Hydrocyanic acid gas.

18 Great care should always be exercised in fumigating with this gas as it is very poisonous and damage to plant and animal life may result from the careless use of it.

19 The leaf blight of the tomato (*Cladisporium fulvum*) Cooke, is very injurious if permitted to gain a foothold early in the growth of the plants. When present in a mild form toward the close of the fruiting period of the tomato, the damage resulting is in part offset by the earlier ripening of the crop. The Bordeaux mixture has proven beneficial as a preventive of the trouble.

20 The dry or tip rot of the tomato becomes very destructive when allowed to have its way. This trouble seldom occurs to a harmful extent when there is an abundance of moisture in the soil.

21 Baskets holding five pounds are a very satisfactory size in which to market the fruit. When shipped they are packed in crates holding four baskets each.

22 Tomatoes when forced under glass are more inclined to grow irregular than when grown in the field; hence in selecting varieties for forcing it is important that they be such as naturally grow smooth.

23 The Beauty and Stone are very satisfactory varieties for forcing. The Beauty is of better appearance than the Stone but the Stone is more prolific and because of greater firmness is better for long distance shipments. The Magnus, because of open foliage, is a good variety to force in ground beds.

24 Frogmore's Selected Forcing, Earliest of All and Combination are promising sorts but need further trial to prove their true value.

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